Space Weather Technical Forecast

Issued on Monday, 09 September 2024 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares remain likely throughout. A glancing CME could give a chance of G1-G2 Minor-Moderate Storms on Day 2 or 3 (10-11 Sep).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity is Moderate with a peak flare of M1.5 at 08/1530UTC from near AR3811 in the southwest. There are thirteen sunspot regions on the disc. A broad complex of small spots in the south centre disc is now assessed as four regions AR3813, AR3815, AR3818 and AR3820, although SDO imagery hints at some connection between these, along with a filament that continues back to AR3811. AR3814 in the northeast still consists of a weak delta spot in its trailing portion, although some of its peripheral spots have been decaying. AR3806 and AR3808 are becoming difficult to assess as they approach the west limb. Newly numbered AR3821 in the northwest has seen smaller spots consolidating into two larger spots. The remaining spot regions are generally small and stable.

No Earth-directed CMEs have been observed during the period.

Solar Wind / Geomagnetic Activity: Slow wind conditions persisted at L1 with observed solar wind speeds by ACE and DSCOVR generally at slow-ambient levels, currently around 350km/s. Density was mostly below average. Interplanetary Magnetic Field, Bt, was Weak to Moderate, in the range 7-10nT, with north-south component, Bz, variable in direction and in the range -8nT to +8nT. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 continued easing after the slight, but below S1 Minor Radiation storm, enhancements since 01 Sep, but remained just above background. High energy electron flux (greater than 2MeV) observed by GOES16 was mainly Background to Moderate. The associated 24-hour fluence remained below the Active threshold, with 3.41e6 integrated pfu observed at 08/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast with M-flares likely through the period, but with a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: A possible HSS from CH65/+ may see an increase in solar winds early on Day 1 (09 Sep), but this is currently late and so is low confidence. CME influences from a large filament eruption on 08 Sep are likely to give a glancing blow at Earth late on Day 2 (10 Sep) or early on Day 3 (11 Sep).

Overall, generally Quiet (Kp1-2) geomagnetic activity is expected at first, with any fast wind arrival possibly seeing Active (Kp4) intervals and a slight chance of G1/Minor Storm (Kp5) levels. Late on Day 2 (10 Sep), or early on Day 3 (11 Sep), a glancing blow from the filament eruption CME is likely, with a chance of G1-G2/Minor-Moderate Storm levels (Kp5-6) being reached. The effects of this CME may linger on into Day 4 (12 Sep), but likely at a reduced level.

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Energetic Particles / Solar Radiation: High energy proton flux is expected to continue easing towards background, but with a slight chance of further enhancements from any notable flares, the risk increasing slightly as the south-centre regions move across the western disc. High energy electron flux is expected to be Background to Moderate levels The associated electron fluence is expected to stay below Active.

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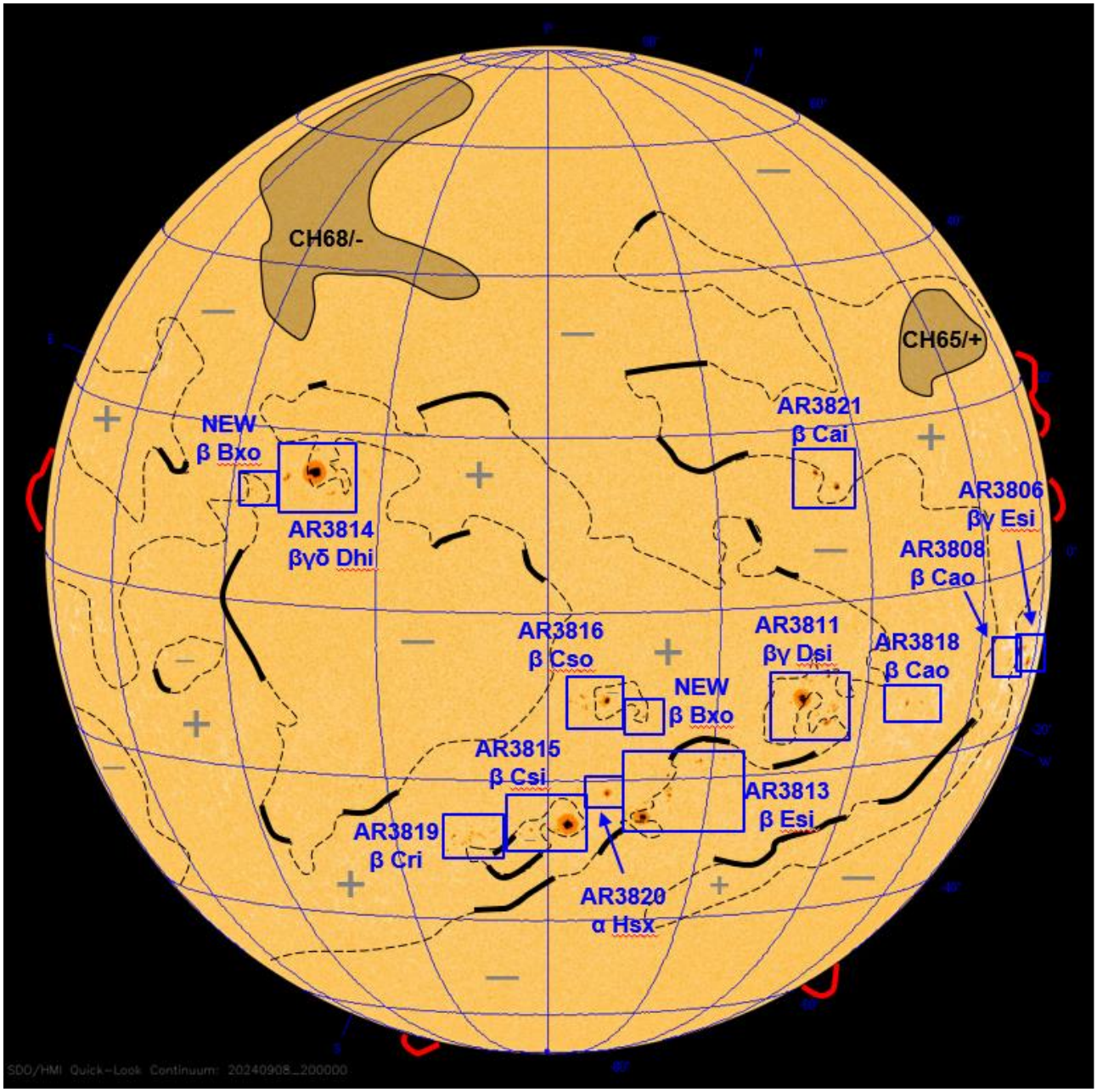
Figure 1. Solar Analysis Valid 08/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Slow wind conditions expected at first. A connection to the fast wind from CH65/+ in the northwest disc was initially thought to be likely on 08 Sep, although no evidence of this has been observed as of yet. A connection may yet arise early on Day 1 (09 Sep) albeit with low confidence. Solar winds perhaps becoming slightly elevated and geomagnetic activity increasing to give some Active intervals, with a slight chance of reaching G1/Minor Storm levels.

A CME from the filament eruption that occurred early on 08 Sep is likely to give Earth some glancing influence, either late on Day 2 (10 Sep) or early on Day 3 (11 Sep), with the bulk of its ejecta expected to pass ahead of Earths orbit. The arrival of this glancing CME could give the chance of a G1-G2/Minor-Moderate Storm, especially if its a more direct hit.

In summary, generally Quiet (Kp1-2) geomagnetic activity is expected at first, with any fast wind arrival possibly seeing Active (Kp4) intervals and a slight chance of G1/Minor Storm (Kp5) levels. Late on Day 2 (10 Sep), or early on Day 3 (11 Sep), a glancing blow from the filament eruption CME is likely, with a chance of G1-G2/Minor-Moderate Storm levels (Kp5-6) being reached. The effects of this CME may linger on into Day 4 (12 Sep), but likely at a reduced level.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	30	40	10
Strong	G3	No	1	5	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
08/0525UTC	Partial	Filament	NW	700 km/s	11/0000UTC +/- 12hrs	Glancing blow likely.

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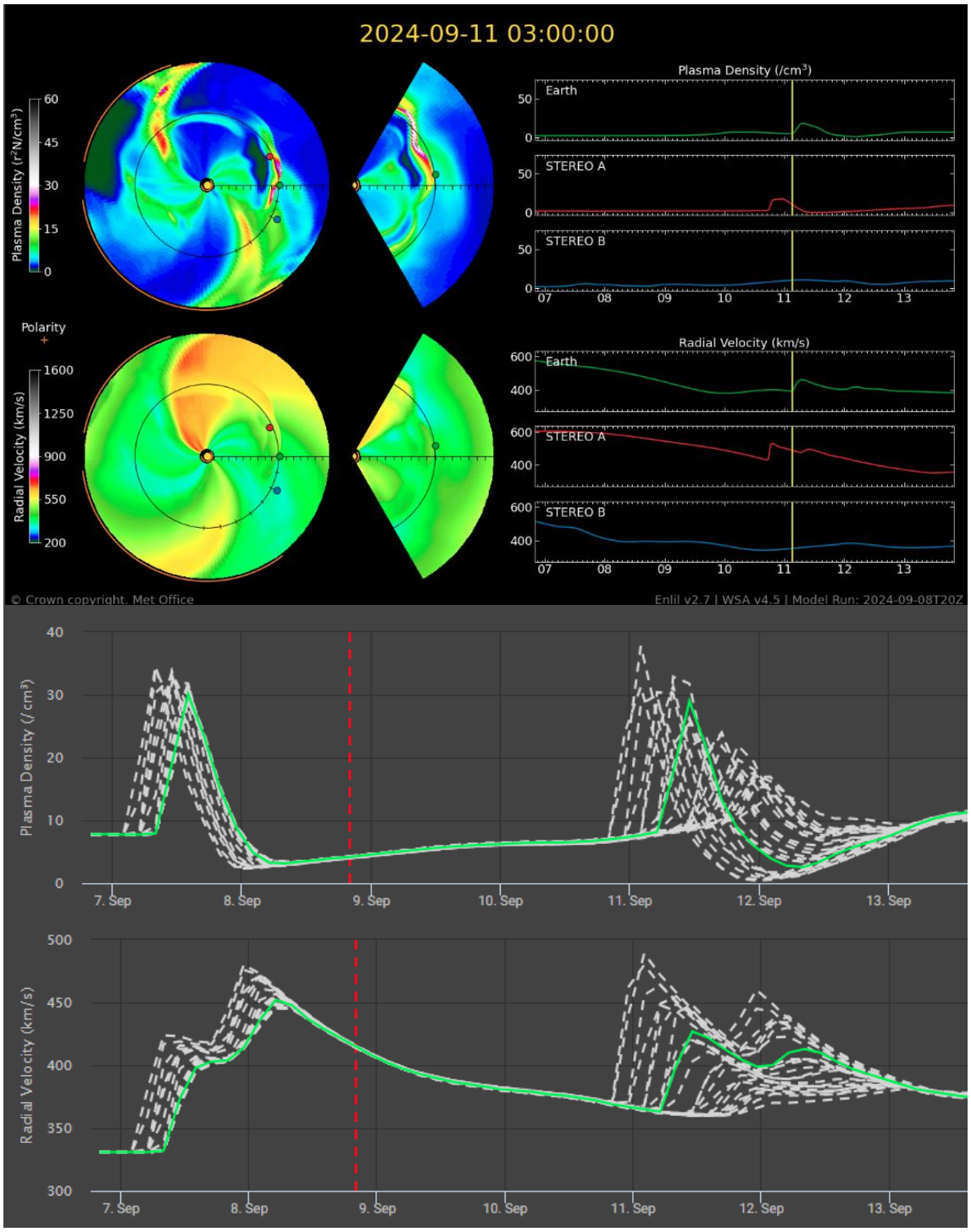
Figure 2: MOSWOC Enlil and Ensemble models showing possible CME arrival time.



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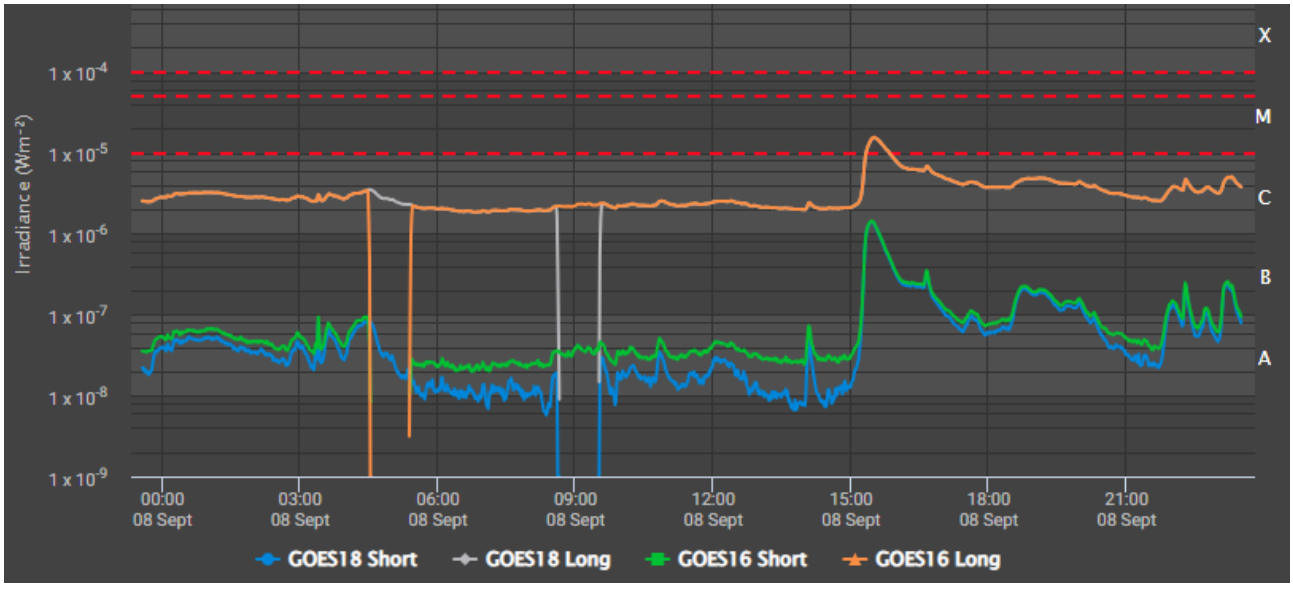
Radio Blackouts - X-Ray Flares:

Activity is at Moderate levels with a peak flare of M1.5 at 08/1530UTC from near to AR3811 in the southwest. Low to Moderate activity is forecast with further M-class flares likely, and a slight chance of an isolated X-class flare.

There are thirteen sunspot regions on the disc, with a few notable areas of potential flares, albeit currently remaining largely inactive. A broad complex of small spots in the south centre disc is now assessed as four regions AR3813, AR3815, AR3818 and AR3820, although SDO imagery hints at some connection between these, along with a filament that continues back to AR3811. These spots are relatively simple, with limited areal extent, and some sign of weakening, however given a history of notable flaring and the overarching magnetic field, further development or activity cannot be ruled out. AR3814 in the northeast still consists of a weak delta spot in its trailing portion, although some of its peripheral spots have been decaying. AR3806 and AR3808 are becoming difficult to assess as they approach the west limb. Newly numbered AR3821 in the northwest has seen smaller spots consolidating into two larger spots. The remaining spot regions are generally small and stable.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: GOES-16 & -18 X-ray flux.



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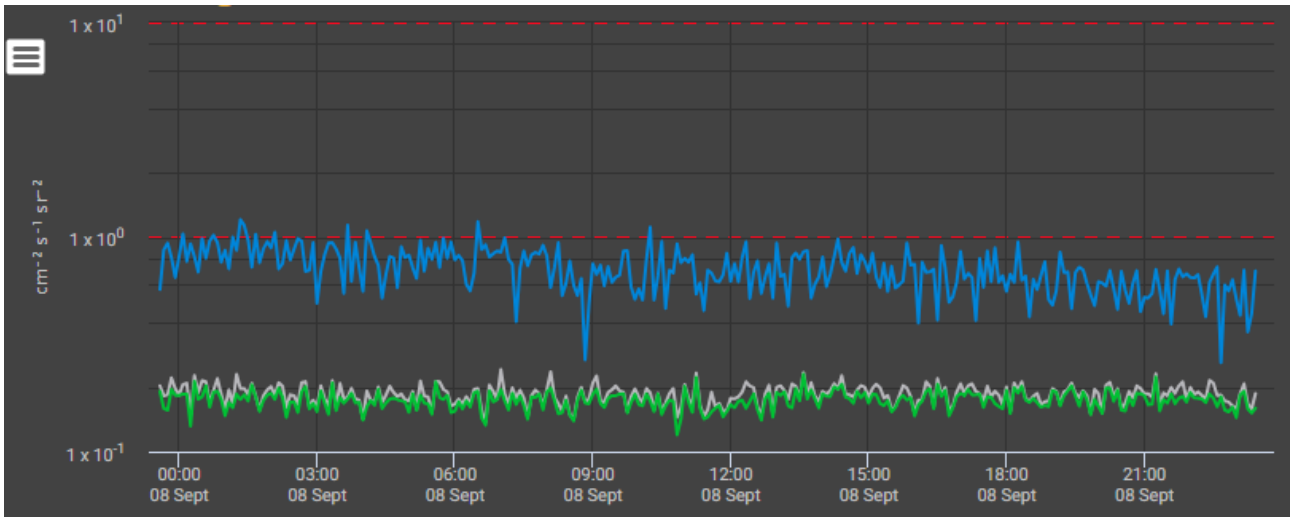
Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18 is currently easing back towards background, and this is expected to continue through the period. The recent below S1 Minor Radiation storm level enhancement was from the 01 Sep M5.5 flare on the SE limb, but further contributions likely from the far-side eruption from over the NW limb on 03 Sep that also saw a notable response at higher energies (greater than 50 and 100 MeV).

There is currently only a slight chance of further events that would lead to proton flux at GEO rising above the S1 Minor Radiation storm threshold. However, this chance does rise a little later in the period when the sunspots regions currently in the south-centre disc move to a more geoeffective location.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-18 Proton flux.



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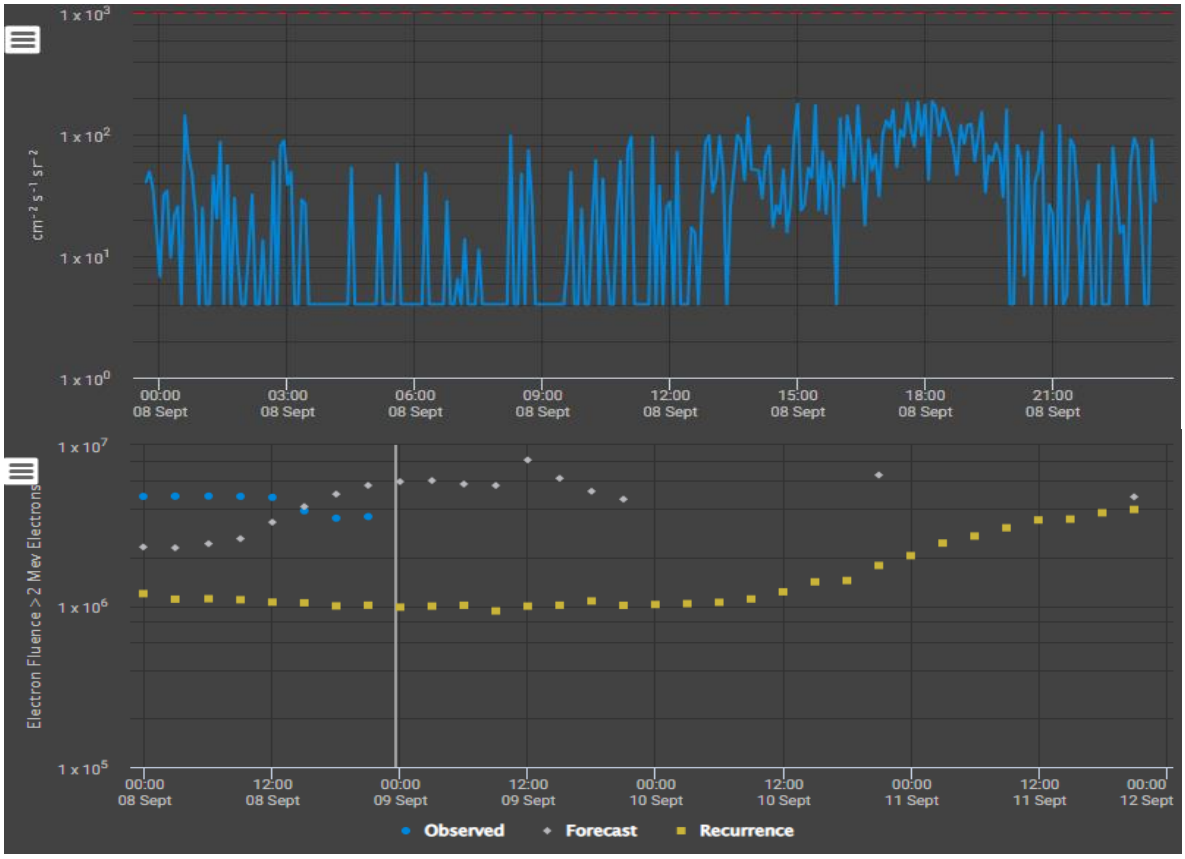
High Energy Electrons Event (≥ 2MeV):

High energy electron flux as observed by GOES-16 has been Background to Moderate. Onset of any fast wind may initially lead to flux levels becoming more persistently background for a time, with a recovering then likely later Day 2. Given the expected arrival of a glancing CME later Day 2 or early Day 3 however, electrons should become suppressed once again, likely staying that way for the remainder of the period.

Overall, the 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold throughout the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 Electron flux and REFM.



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